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# GEOLOGY OF WATER IN OHIO

by

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*Delaware Formation*

Orton, in 1878, gave the formation the name Delaware on account of its prominent occurrence at Delaware and of its extensive use at this place.<sup>1</sup> The same group of rocks had been named Sandusky by Newberry in 1873. The Delaware formation or its approximate equivalent in time is present in two areas in Ohio. The main field is in the central part of the State in a long narrow belt extending from western Pickaway County northward past Columbus, Delaware, Marion, and Bellevue to Sandusky on Lake Erie. The other area is in northwestern Ohio in western Lucas, northwestern Wood, central Henry, southern Defiance, and northern Paulding counties. Here the deposits are known as Traverse and are equivalent in time to the Delaware and the Olenangy of central Ohio. This formation is wanting in the Bellefontaine outlier in Logan County for there the Columbus limestone is directly overlain by the Ohio shale.

The strata are of marine origin and in general fairly fossiliferous. The formation ranges from 30 to 70 feet in thickness and averages close to 45 feet. It varies in character from shales with thin limestone layers to rather massive limestones with only bedding-plane partings of shaly matter. The best stone is in the area from Delaware northward to Sandusky. In general the limestone layers are rather evenly bedded and from 2 to 12 inches in thickness. Locally some of the layers thicken to 1 foot 6 inches to 2 feet. The color range of the stone is from light to very dark bluish gray. The composition is that of an impure limestone. The stone is dense, tough, and durable. The Delaware ranks as a good building stone and has been used quite extensively for many years for architectural work and for heavy masonry. It is also drawn upon for crushed stone for railroad ballast, road metal, and concrete aggregate.

In general the Delaware limestone is too hard and dense to act as a storage reservoir. It is thin to medium bedded and much jointed. At the surface and under shallow covering weathering and solution open up the deposits sufficiently for the accumulation of small supplies. Owing to pyrite the water in the Delaware formation is often highly charged with deleterious matter.

*Olenangy Formation*

The Olenangy formation lying above the Delaware limestone and below the Ohio shale is a gray, siliceous, calcareous shale with plastic clay-like properties. It was named by N. H. Winchell, in 1874, from exposures along the Olenangy River at Delaware.<sup>2</sup> Where typically developed the formation varies from 15 to 30 feet in thickness. At present

<sup>1</sup> Geol. Survey Ohio, Vol. III, p. 486, 1878.<sup>2</sup> Geol. Survey Ohio, Vol. II, p. 387, 1874.

## MISSISSIPPIAN SYSTEM

The Mississippian is one of the large systems of rocks in Ohio. It is well described by Lamborn as follows:<sup>3</sup>

"Rocks of Mississippian age in Ohio outcrop over a belt of varying width, extending from the Ohio River in Scioto County north to Huron County and then northeastward, meeting the Pennsylvania line in Trumbull and Ashtabula counties. This belt of outcrops has a width of 20 to 25 miles at its southern end, but its width increases to the north to as much as 50 miles as measured across Huron, Ashland, and Wayne counties. From this latter region the belt narrows to the eastward, in western Trumbull and eastern Geauga counties the zone of outcrops being not more than 5 miles in width. In the northwestern corner of the State, including parts of Williams, Defiance, and Fulton counties, the bedrock in contact with the glacial drift is of Mississippian age. The area in Ohio over which rocks of Mississippian age outcrop is about 8,586 square miles or a little more than 20 per cent of the area of the State.

"The Mississippian rocks of Ohio, with the exception of the Maxville limestone, are of the elastic varieties such as shale, sandstone, and conglomerate. The sediments forming this series were originally deposited in shallow waters close to the shore. As a result of either a change in the position of the shore by earth movements or of marked changes in climatic conditions there was a frequent shifting of the zones of deposition in such a way that the sediments deposited and later consolidated into bedrock show marked variations in character in both a horizontal and vertical direction. For these reasons the characteristics of the group often show considerable change from one locality to another. The thickness of the group is also subject to much variation, due in part to difference in thickness of the sediments originally deposited and in part to the different amounts removed by erosion preceding Pennsylvanian time. In Scioto County, Stout estimates the total thickness to range between 600 to 800 feet. The group apparently thickens to the north for in Ross and Vinton counties Hyde reports the Waverly series to be represented by about 1,000 feet of sandstone, shale, and conglomerate. Estimates of the thickness of this group in Muskingum County, based on drillers' records, show variations ranging from 700 to 900 feet. In Wayne County, the maximum thickness approaches 1,000 feet. In Cuyahoga County the thickness of the Mississippian approaches 550 feet at South Brooklyn and Prosser reports a thickness of 323 feet along Brandywine Creek at the southern edge of the county. At Gates Mills in the northeastern part of Cuyahoga County the thickness is about 288 feet, and along Phelps Creek

<sup>3</sup> Geol. Survey Ohio, 4th Ser., Bull. 39, pp. 41-43.

(1941) it is of no practical importance, but formerly it was worked at Delaware for building block and drain tile.

Owing to the soft clay-like nature of the Olenangy shale it is of no value as a water resource. The oxidation of the fine crystals of pyrite is detrimental to water from other sources coming in contact with the shale.

*Ohio Formation*

The thick mass of shales in the upper part of the Devonian system was called the Ohio by Andrews in 1870.<sup>4</sup> It is made up of three members: Huron, Chagrin, and Cleveland. These units, however, are not sharply defined and regionally are quite variable. The Huron and Cleveland are typically black or brownish black, fissile shales with a high content of carbonaceous matter in a fine state of division. Pyrite either in fine crystals or in nodules or flakes is also a common impurity. The Chagrin or middle unit is a gray, siliceous shale differing from the others through lack of organic and pyritic matter. The Ohio formation outcrops in three widely separated areas in Ohio. The main field crosses the central part of the State in a belt from 8 to 20 miles in width. It extends from Adams County on the Ohio River to Erie County on Lake Erie, thence eastward along the Lake front to Ashtabula County. The second field, largely buried by drift, is present in northwestern Ohio in western Lucas, eastern Fulton, northwestern Henry, northern Defiance, and southern Williams counties. The third area, much smaller in size, is found around the Bellefontaine outlier in Logan County.

This division of rocks varies from less than 400 feet in thickness in Pike County to 3,400 feet, under deep covering, in Jefferson County. Normally these shales thicken from 20 to 30 feet per mile to the east and from 5 to 15 feet per mile to the south. These black shales are interesting as during the late 50's they were utilized at Buena Vista for the distillation of kerosene. Far in the future they may again be employed for their yield of oil and gas. In northern Ohio, especially in the Cleveland district, the Chagrin member is utilized for ceramic products such as building brick, paving block, hollow block, and drain tile.

The Ohio shale with its impoverishment of water is a factor of importance as it covers large areas in central and northeastern Ohio. About the only absorption is along joint and bedding planes in the zone of weathering at or near the surface. Owing to pyrite and organic matter the small supplies of water found in the shale are usually too impure for human consumption.

<sup>4</sup> Andrews, E. B. Geol. Survey Ohio, Rept. of Progress in 1870. Part II, p. 62.

in Ashtabula and Geauga counties it is 346 feet. Due to the variable character of the Mississippian rocks, a detailed classification which is applicable to one section does not necessarily apply to a region remotely distant. In general the Mississippian of Ohio can be grouped into the following formations, the Bedford, Berea, Sunbury, Cuyahoga, and Maxville."

*Bedford Formation*

The Bedford shale was named by Newberry in 1870 from the outcrops at Bedford, southeast of Cleveland.<sup>5</sup>

It is the oldest formation of the Mississippian system and really inaugurates the beginning of a large series of siliceous deposits, including a variety of shales and sandstones. These rocks are of marine origin and were laid down in shallow water. The formation is made up largely of shales which vary in character from soft, clay-like material of a pink, mottled, or chocolate color to hard, siliceous shale of light gray to dark bluish gray shale. In the Cleveland district a group of sandstone layers known as the Euclid lentil appears in the basal portion of the formation. In southern Ohio the soft, pink shale is absent and the gray shale becomes decidedly siliceous; in fact it contains many thin layers of ripple-marked sandstone. The Bedford formation outcrops in a narrow belt extending from the Ohio River near Buena Vista in Scioto County to Lake Erie near Lorain, thence eastward to the Ohio-Pennsylvania line in southern Ashtabula County. It varies in thickness from 50 to 110 feet, but averages close to 85 feet. Local supplies of building stone are quarried from the Euclid lentil in the Cleveland district. The stone is of good quality for flagging, sills, caps, and general masonry. Locally both the gray and pink shales are utilized for ceramic purposes.

The Bedford is not a water-bearing formation whether of the clay-like or of the siliceous type of shale. The sandstone of the Euclid lentil of northern Ohio or of thin-bedded layers of southern Ohio are too tight and dense for any available supply. The Bedford, therefore, rates along with other shale formations in containing little or no rock water.

*Berea Formation*

The Berea, named by Newberry in 1870, is one of the well known deposits in Ohio, for it is important as a source of abrasives and building stone, as an oil sand for the production of petroleum and natural gas, and as a water-bearing horizon yielding sweet-water to strong brine. It is very persistent across the eastern part of Ohio, seldom being wanting even

<sup>5</sup> Geol. Survey Ohio, Report of Progress in 1869, Part I, p. 21; Vol. I, Part I, pp. 189, 192.

the village. In this the glacial materials are rather well sorted and should provide water storage.

**Floor levels:** No deeply buried valleys are known in the area.

**Rocks:** The Berea sandstone outcrops along the banks of the Sandusky River to the west and directly south of the village. Under cover this should provide water in moderate quantities.

**Sulphur water and brines:** The underlying rock will yield sulphur water, if any, and the deep-seated carbonate rocks strong brine.

**Present supply:** The supply, 1941, is from common wells.

**Possibilities:** The Berea sandstone under covering, the Sandusky River direct, and the Leesville esker constitute the possible sources.

#### NEW WASHINGTON

Population: 857

**Streams:** This village lies on the Mississippi Valley Plain, on a rather smooth, glaciated surface, at an elevation of 992 feet (B.M.), and near the small, mere run-like, headwaters of Brokenknife Creek, a tributary of Honey Creek.

**Glaciation:** Both the Illinoian and Wisconsin ice sheets passed over the area. The village lies at the north edge of the Ft. Wayne moraine. In general, however, the drift is variable but thin, ranging from 5 to 50 feet in thickness.

**Floor levels:** No buried valleys are known in the area.

**Rocks:** New Washington lies on the lower half of the Ohio shale. The top of the Delaware limestone is reached at a depth approximating 200 feet and the top of the water-bearing horizon in the Columbus at some 300 feet.

**Sulphur water and brine:** Sulphur water and then brine are encountered in all deep tests.

**Present supply:** The supply, 1941, is surface water filtered and chlorinated before use.

**Possibilities:** Pondered surface water appears to be about the only source of a water supply unless the underlying carbonate rocks may yield potable rock water. However, the rock water is high in fluorine, four parts per million.

#### OSCEOLA

**Streams:** Osceola lies on the glaciated, gently-rolling Mississippi Valley Plain, at an elevation approximating 935 feet, and just

springs are also present in the area. The water is strongly impregnated with hydrogen sulphide and some mineral components.

**Present supply:** The supply, 1941, is from common wells and springs.

**Possibilities:** Potable water in moderate quantities should be obtained about one mile south of the village along the crest of the Wabash moraine.

#### TIRO

Population: 315

**Streams:** Tiro lies on the glaciated, moderately-rolling Mississippi Valley Plain, at an elevation approximating 1,042 feet, and at heads of southern and eastern tributaries, mere runs, of Honey Creek.

**Glaciation:** Both the Illinoian and Wisconsin ice sheets passed over the area. The village lies on the northern flank of the Wabash moraine. In general, however, the drift is thin, averaging less than 50 feet.

**Floor levels:** No deeply buried valleys are known in the area.

**Rocks:** The Berea sandstone outcrops just east of the village at an elevation not far from 1,050 feet. It is the only rock formation in the area that may yield rock waters.

**Sulphur water and brine:** The underlying shales will yield sulphur water and the deep-seated strata will give only brines.

**Present supply:** The supply, 1941, is from common wells in the glacial drift.

**Possibilities:** The Berea sandstone eastward under cover and the thin drift are the only solutions for a water supply.

#### CUYAHOGA COUNTY

##### BEDFORD

Population: 7,390

**Streams:** Bedford lies on the glaciated, gently-rolling but dissected Allegheny Plateau, near the top of the Portage escarpment, at an elevation approximating 960 feet, and north of Tinkers Creek, draining parts of several townships.

**Glaciation:** The Wisconsin glacier passed over the area and left a variable thickness of drift, 10 to 60 feet. It provides only small quantities of water.

**Floor levels:** Evidence of a buried valley is indicated by the drill,

north of Broken Sword Creek, a stream draining parts of several townships.

**Glaciation:** Both the Illinoian and Wisconsin ice sheets passed over the area but in general left only a thin coating of drift, averaging not more than 25 feet and consisting largely of till. The border of the Ft. Wayne moraine lies about two miles to the northwest of the village and that of the Wabash moraine three miles to the southeast.

**Floor levels:** No deeply buried valleys are known in the area.

**Rocks:** The rocks outcropping along Broken Sword Creek near Osceola are limestones belonging near the top of the Columbus formation. The lower strata of this formation and the top of the underlying Monroe should yield fair supplies of rock water.

**Sulphur water and brine:** Deep drilling will first produce sulphur water and then brine.

**Present supply:** The supply, 1941, is from common wells.

**Possibilities:** The underlying carbonate rock and Broken Sword Creek are the most apparent sources for a water supply. The rock water offers a plentiful supply for domestic use.

#### SULPHUR SPRINGS

Population: 260

**Streams:** This village lies on the glaciated, moderately-rolling Mississippi Valley Plain, at an elevation approximating 1,026 feet (B.M.), and near the headwaters of one of the small southern tributaries of Broken Sword Creek. The streams adjacent to the village are mere runs.

**Glaciation:** Both the Illinoian and Wisconsin ice sheets passed over the area. The village lies on the northern edge of the Wabash moraine. The drift, however, is not especially thick, being from 10 to 75 feet and locally more or less sorted. It provides small supplies.

**Floor levels:** No buried valleys are known in the area.

**Rocks:** Sulphur Springs lies on the basal portion of the Ohio shale, about 250 feet above the Berea sandstone.

**Sulphur water and brine:** The underlying Ohio shale yields sulphur water and the deeper-seated carbonate rocks brackish water and brine. The Knisely springs issue from the underlying shales at this place. These consist of eleven different springs issuing in an area of four square rods in a little basin along the small run. Other

about one and one-half miles north of the town. Here the drift is from 70 to 120 feet in thickness and the rock floor stands at about 900 feet elevation.

**Rocks:** Bedford is placed on the Orangeville shale, above the Berea sandstone, which outcrops prominently along Tinkers Creek west of the town. Eastward under cover, the Berea should provide small supplies of water.

**Sulphur water and brine:** Sulphur water, if any, will be encountered in the underlying Bedford and Ohio shales and brine in the deeper Devonian and Silurian carbonate rocks.

**Present supply:** Water served from Cleveland.

**Possibilities:** Tinkers Creek offers the only local supply.

#### Berea

Population: 6,025

**Streams:** Berea lies on the glaciated, relatively smooth but dissected Mississippi Valley Plain, about two miles northwest of the border of the Allegheny or Portage escarpment, four and one-half miles southeast of the beach ridge of old Lake Maumee, just east of the East Branch of the Rocky River, and at an elevation approximating 780 feet.

**Glaciation:** The Wisconsin glacier passed over the area but in general left only a thin coating of drift, averaging not more than 25 feet.

**Floor levels:** A buried valley is present about one mile east of Berea. In this the fill is from 100 to 200 feet in thickness. The rock floor stands at an elevation not far from 610 feet. It should bear fair supplies of water.

**Rocks:** The Berea sandstone forms prominent outcrops along East Branch in the vicinity of the town. Followed to the southeastward under cover it may provide small supplies of water.

**Sulphur water and brine:** All deep tests encounter sulphur water and brine.

**Present supply:** The supply, 1941, is from the East Fork of Rocky River. The water is filtered and chlorinated.

**Possibilities:** The water resources are confined chiefly to the buried valley to the east of the town and to East Branch direct.

**CHAGRIN FALLS**  
Population: 2,508

**Streams:** Chagrin Falls lies on the glaciated, moderately-rolling, and dissected Allegheny Plateau, at an elevation approximating 580 feet; and on both banks of the Chagrin River, here a stream draining parts of a few townships.

**Glaciation:** The area was glaciated by the Wisconsin ice sheet. In general the drift is thin, less than 25 feet.

**Floor level:** A buried valley lies west of the village, along the general course of the Chagrin-Aurora Branch. The rock floor is reported at about 800 feet elevation.

**Rocks:** The Berea sandstone forms the falls at Chagrin Falls. To the east under cover it may provide small supplies of water.

**Sulphur water and brine:** Sulphur water, if any, will be encountered in the Bedford and Ohio shales and brine in the Devonian and Silurian carbonate rocks.

**Present supply:** The supply, 1943, is from springs and four drilled wells, 94 to 240 feet in depth. The water is chlorinated for disinfection.

**Possibilities:** The water resources are confined to the Chagrin River and the Berea sandstone.

**CLEVELAND**  
Population: 878,336

**Streams:** Cleveland lies on both the glaciated Lake Plain and the Mississippi Valley Plain, fronts on Lake Erie, and is cut by the Cuyahoga River.

**Glaciation:** The Wisconsin ice sheet passed over the area but in general left only a thin coating of drift, averaging less than 25 feet.

**Floor levels:** Post-Illinoian Massillon River passed through the eastern part of Cleveland. The rock floor locally is close to sea level, elevations ranging from 13 feet below to 200 feet above tide. The fill in this old valley, however, is largely till and clays, hence it yields only small supplies of water.

**Rocks:** Cleveland is underlain largely by the Bedford, Cleveland, and Chagrin shales, bearing no potable waters.

**Sulphur water and brine:** All deep tests encounter sulphur water and brine.

**Sulphur water and brine:** All deep tests encounter sulphur water and brine.

**Present supply:** Water supply served from Cleveland.

**Possibilities:** The water resources are confined to the Cuyahoga River and to the fill of the old Massillon River.

**OLMSTED FALLS**  
Population: 734

**Streams:** Olmsted Falls lies on the glaciated, relatively smooth, but dissected Mississippi Valley Plain, nearly three miles southeast of the beach ridges of old Lake Maumee, at an elevation approximating 770 feet, and on the uplands west of the West Branch of the Rocky River at the mouth of Plum Creek, a western tributary.

**Glaciation:** The Wisconsin ice sheet passed over the area and left a thin and variable coating of drift, from 10 to 50 feet.

**Floor level:** A buried valley, Olmsted Falls Creek, is present in the area.

**Rocks:** The Berea sandstone outcrops prominently along the streams in that vicinity and forms the falls, thus designating the place.

**Sulphur water and brine:** All deep tests encounter sulphur water or brine.

**Present supply:** Supply, 1941, is served from Cleveland.

**Possibilities:** The water resources are confined to the streams, West Branch of Rocky River and Plum Creek.

**ROCKY RIVER**  
Population: 8,291

**Streams:** Rocky River lies on the flat, glaciated Lake Plain, just south of Lake Erie, west of Rocky River, along the beach ridge of old Lake Maumee, and at an elevation approximating 670 feet.

**Glaciation:** The Wisconsin glacier passed over the area but regionally the drift is thin, averaging not more than 20 feet.

**Floor level:** The trough of a buried valley, Olmsted Falls Creek, extending from Berea to the Lake, lies just west or in the western portion of Rocky River. The maximum fill is about 180 feet and the rock floor falls to 530 feet above tide.

**Rocks:** The underlying rocks are the shales of the Chagrin formation. They provide no potable water.

**Present supply:** The supply, 1941, is from Lake Erie and is filtered and chlorinated.

**Possibilities:** Large supplies must come from Lake Erie.

**GATES MILL**  
Population: 900

**Streams:** Gates Mill lies on the glaciated, but deeply dissected Allegheny Plateau, at an elevation approximating 729 feet (B. M.), and on the flood plain and bluffs of the Chagrin River.

**Glaciation:** The Wisconsin ice sheet passed over the area but left only a thin and variable coating of drift, averaging less than 25 feet.

**Floor level:** The rock floor at Gates Mill stands at about 580 feet and thus the fill is approximately 150 feet in thickness. This fill should provide small supplies of water.

**Rocks:** The rocks along the deep valley are Cleveland shale at the top and Chagrin shale in the middle and lower portions. Hence no rock water is available.

**Sulphur water and brine:** All deep tests will encounter sulphur water and then brine.

**Present supply:** The supply, 1941, is from local wells.

**Possibilities:** The water resources are confined to the fill along the valley and to the Chagrin River direct.

**INDEPENDENCE**  
Population: 1,815

**Streams:** Independence lies on the glaciated, rolling, but dissected Mississippi Valley Plain, near the foot of the Portage escarpment, at an elevation approximating 860 feet, and about three-fourths mile west of the Cuyahoga River.

**Glaciation:** The Wisconsin glacier passed over the area. The drift varies from 5 to 60 feet but averages not more than 25 feet. It bears little water.

**Floor level:** Independence lies at an elevation of 860 feet, the Cuyahoga River at 595 feet, and the rock floor of the old Massillon River—in the Cuyahoga Valley—at 250 feet.

**Rocks:** Independence lies on the Berea sandstone. Thus the underlying rocks are the shales of the Bedford and Ohio formations with no potable water supplies.

**Sulphur water and brine:** All deep tests encounter sulphur water and brine.

**Present supply:** Supply, 1941, is served from Cleveland.

**Possibilities:** The water resources are confined to the buried valley west of the town, to Lake Erie, and to Rocky River.

**SOLON**  
Population: 1,508

**Streams:** Solon lies on the glaciated, gently rolling Allegheny Plateau, at an elevation of 1,037 feet (B. M.), and one mile east of a small tributary of Tinkers Creek.

**Glaciation:** The Wisconsin ice sheet passed over the area. Solon lies on the north flank of the Blanchard or Defiance moraine. In general the drift is thick, 25 to 80 feet.

**Floor level:** A buried valley, Ravenna River, is present south of Solon. The rock floor stands about 900 feet elevation and the fill is 140 feet or more in thickness. This old valley should provide large supplies of water.

**Rocks:** The Berea sandstone is present at an elevation not far from 900 feet or about 130 feet from the surface. It should provide small supplies of rock water.

**Sulphur water and brine:** Sulphur water, if any, is present in the Bedford and Ohio shales and brine in the deeper Devonian and Silurian carbonate rocks.

**Present supply:** Supply, 1941, is served from Cleveland.

**Possibilities:** The thick fill in the old valley offers a large water supply.

**DARKE COUNTY**

**ANSONIA**  
Population: 712

**Streams:** This village lies on a comparatively level till plain at an elevation of about 1,005 feet. Stillwater River flows eastward past the northern part.

**Glaciation:** Both the Illinoian and Wisconsin ice sheets passed over the area and conjointly left a thick coating of glacial debris, approximating 100 feet. The Union moraine lies about three and one-half miles to the southwest and the Mississinawa moraine about the same distance to the northeast.

**Floor level:** No data are available on old floor levels.